UNLV Transmutation Research Program

Recent Highlights and Future Directions

Transmutation
Research
Program

AFCI Technical Review

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AFCI Technical Review: UNLV Program

- UNLV Program Overview
  - Major Highlights: 2/03 to Today
  - Current Status of Major Projects
- UNLV Graduate Research Programs
  - Recent Highlights
    - Tasks 1, 2, 8 (due to time constraints)
  - LBE Corrosion (Dr. Allen Johnson)
    - Task 3
  - Materials Work (Dr. Ajit Roy)
    - Tasks 4, 10, 14

Major Program Highlights: 2/03 to Today

- Student Research Projects – Third Year
- High Temperature Chamber (MPL)
- Flow Visualization System
- Oxygen Sensor
- International Collaborations
  - ^{3}He Neutron Detector (KRI)
  - FCC (KRI)
  - Fluorapatite (KRI)
  - TC-1 Support Contract (ISTC/IPPE)

Major Ongoing Projects: Transmission Electron Microscope

- TEM User Laboratory
  - TEM Laboratory:
    - Target Date – 10/1/03
  - TEM Installation:
    - Target Date – 11/1/03
  - Sample Prep Lab Upgrade:
    - Target Date – 11/03
- Current Status
  - TEM Lab:
    - Under Construction
  - Sample Prep:
    - Equipment Down-Selection

FEI Technai F-30 S-Twin

- **300 keV STEM/TEM System**
- **Resolution:** 0.2 nm (spot), 0.12 nm (line)
- **Magnification:** 60X to 1,000kX
- **Elemental and Chemical Analysis**
  - **EDS**
  - **EELS**

Major Ongoing Projects: TC – 1 (LBE Loop)

- Facility Update
  - EH&S Approval Received
    - Installation Approved
    - Operation Approval Expected
  - Construction Start: 8/18/03
- Installation Target Date
  - November ’03
- Design Efforts Underway
  - Gas Handling System
  - Heat Exchanger
- Experimental Work Scope
  - Developed at ISTC Meeting 8/02
  - Under revision
    - (UNLV, IPPE, LANL, others)

Target Complex 1 awaiting installation in UNLV’s Howard R. Hughes College of Engineering.

Scientists from Russia, Los Alamos, and UNLV evaluate the condition of Target Complex 1 after delivery.

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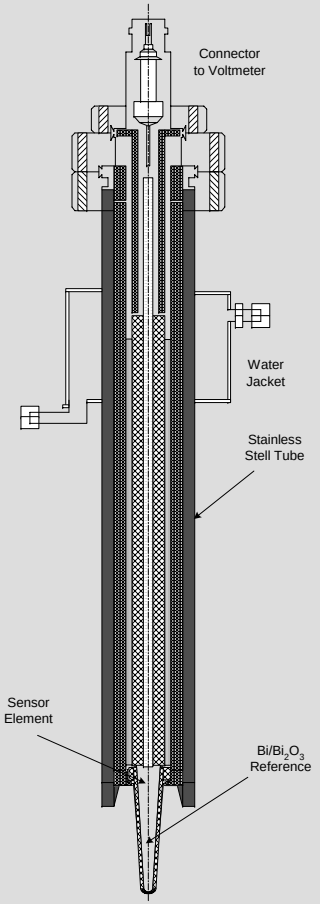
Major Ongoing Projects: LBE Small Experiments

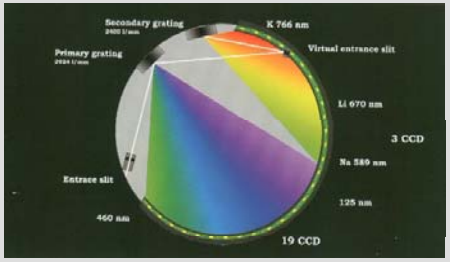
- Molten Metal Small Experiments Facility
  - Interim Facility: Cancelled
  - Permanent Facility: Conceptual Design Phase
- Oxygen Sensor
  - Fabrication complete
  - Moved to LANL for experimental program
- Future LBE Experimental Efforts
  - Bench-scale (gram levels): Existing Laboratories
    - Will coordinate with UNLV EH&S on case-by-case basis
  - Bench/Lab – scale: MMSXF (planned)
    - Deferred awaiting completion of MMSXF
  - TC-1 Prototyping and Research Campaign



Major Ongoing Projects: ICP-AES and Actinide Chemistry Labs

- Actinide Chemistry Lab
  - Target Date: 11/15/03
  - Current Status:
    - A&E Phase
  - Lab Supplies
    - On Order
  - Initial Equipment
    - Transferred to UNLV by Dr. Czerwinski

- ICP-AES User Facility
  - Target Date: 11/15/03
    - Combined with Actinide Chemistry Lab Project
  - Instrument: On Campus
  - Installation Target Date:
    - 12/1/03



UNLV Transmutation Research Program: Planned Activities – Program Year 3

- Major TRP Activities: 9/03 to 4/04 (PY'03)
  - LBE Loop Research Program
  - New Proposal Cycles: Student Research
    - 12 current projects are in their third (and final) year
    - New proposals will be solicited from UNLV researchers
      - May '04 start: Proposals Due to UNLV Director 1/15/04
      - August '04 start: Proposals Due 4/15/04

UNLV Student Research Program

Selected Highlights and Achievements

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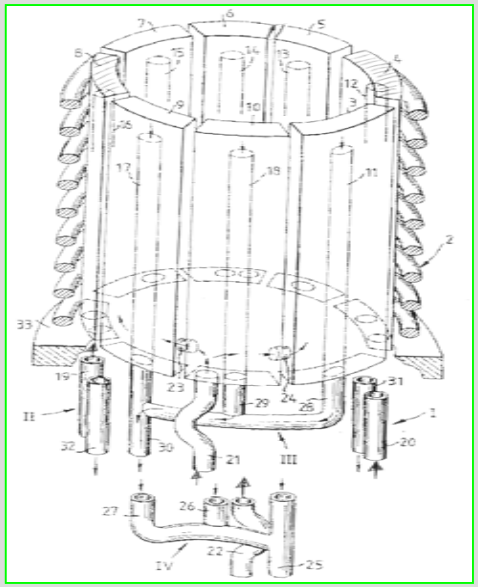
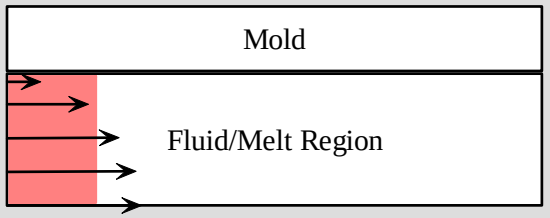
Task 1: Fuel Pin Casting

- Process Model for Casting Completed
  - Able to model casting (including solidification)
  - Parametric study of control parameters complete
    - e.g. mold composition, pre-heating molds, etc.
- Models of Skull Crucible Furnace Underway
  - Goal: Couple Melting Models to Casting Model
- Next Step: Need Experimental data to verify models
  - heat transfer coefficient for melt-mold heat transfer
  - Verify volatility/losses of Am from system



VOF Model



Initial Fill Region

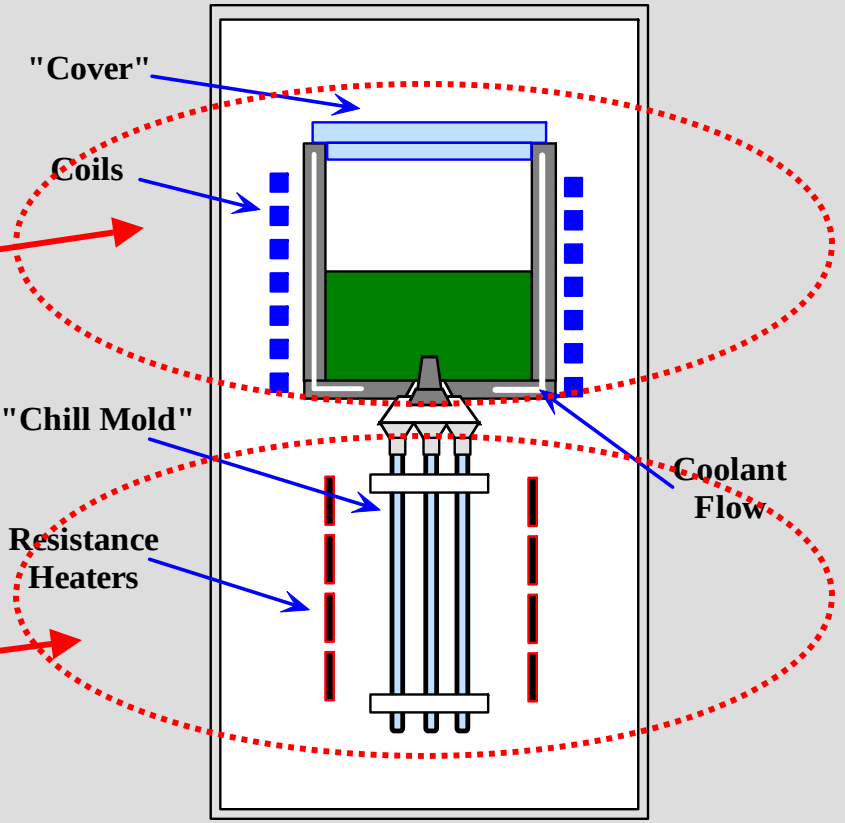
Task 1: Important Phenomena

Heat and Mass Transfer

- *Induction heating of material*
- *Induced fluid flow*
- *Mass Transfer of americium*

Metallic Fuel Pin Casting

- *Heat transfer*
- *Fluid flow (filling)*
- *Solidification*
- *Parametric study*

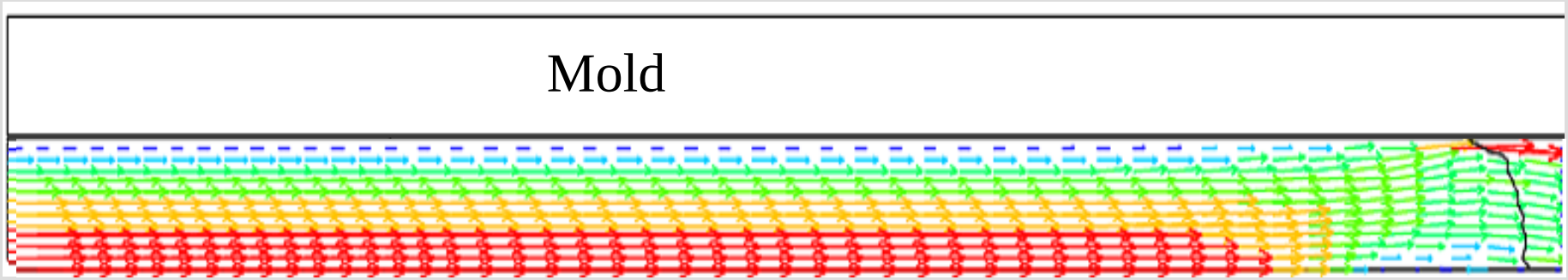


Task 1: Model Results

Non-Slip Filling Process

Filling step: 0.01s~0.07s, Time increase 0.01s

Note: 62,000 nodes are required to model the casting (0.5 m by 4 mm dia.)



Assumption: No solidification

during the filling process

Inlet velocity V=1 m/s,
Mold material: copper,
Inlet temperature: 1,500 ^{o}C
Heat transfer coefficient h=2,000 W/m ^{2} ^{o}C
Mold preheated temperature 800^{o}C

1.Parabolic velocity profile

2.The head of the melt---surface tension

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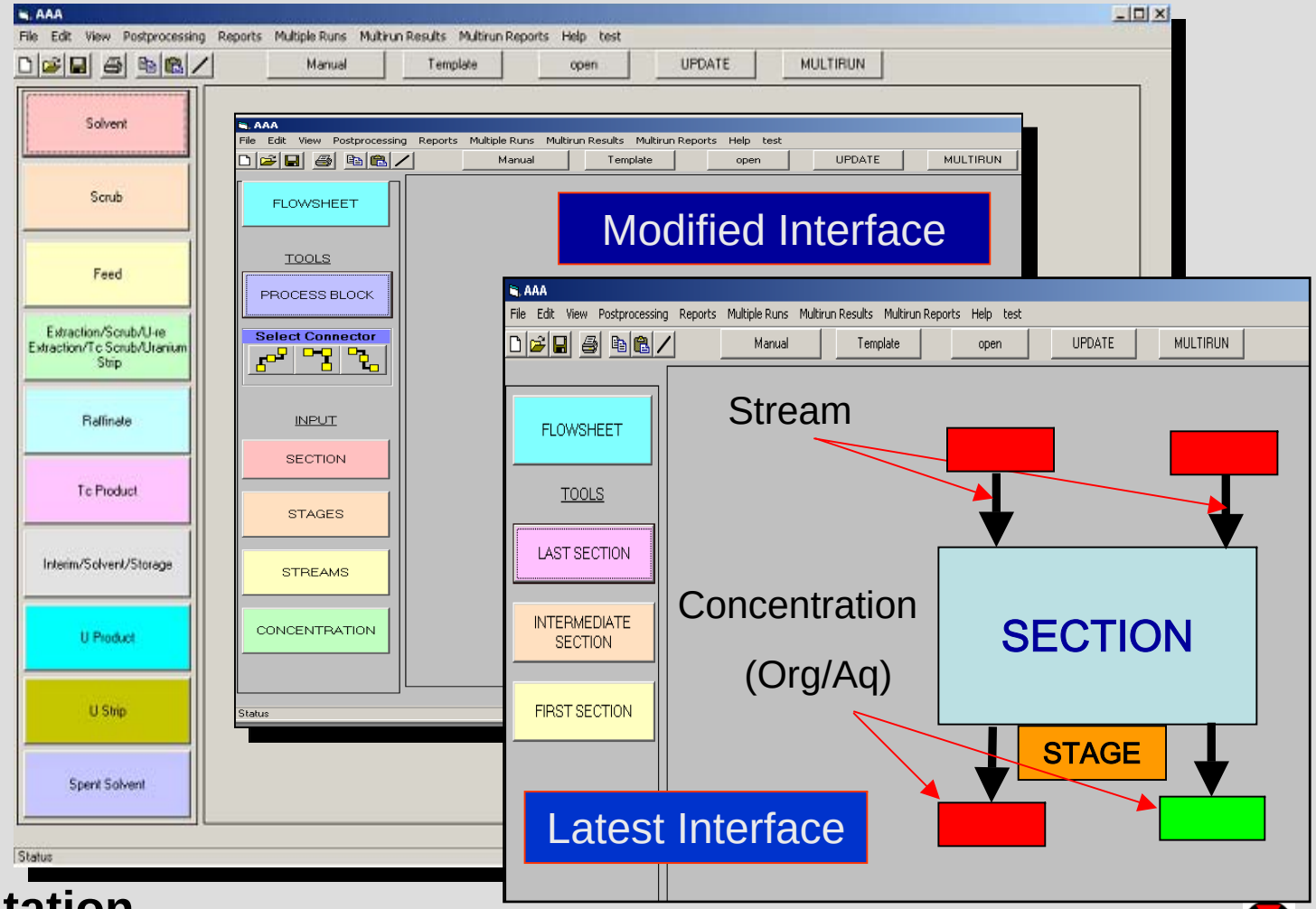
Task 8: Systems Modeling for Separations

- Recent Accomplishments
  - Graphical Interface for AMUSE code complete (Beta version)
    - Provides drag and drop interface for users
    - Provides output available in any format
    - Provides link to systems modeling code
- Current/Future Work:
  - Continue development of GUI to suit ANL needs
    - Developing multi-run interface
    - Add additional flow sheets to system (i.e. for UREX+)
  - Parametric Analysis of UREX process flow sheet
    - Developing Systems Analysis methodology
    - Working with “representative” data and functions

Task 8: Sample Interface



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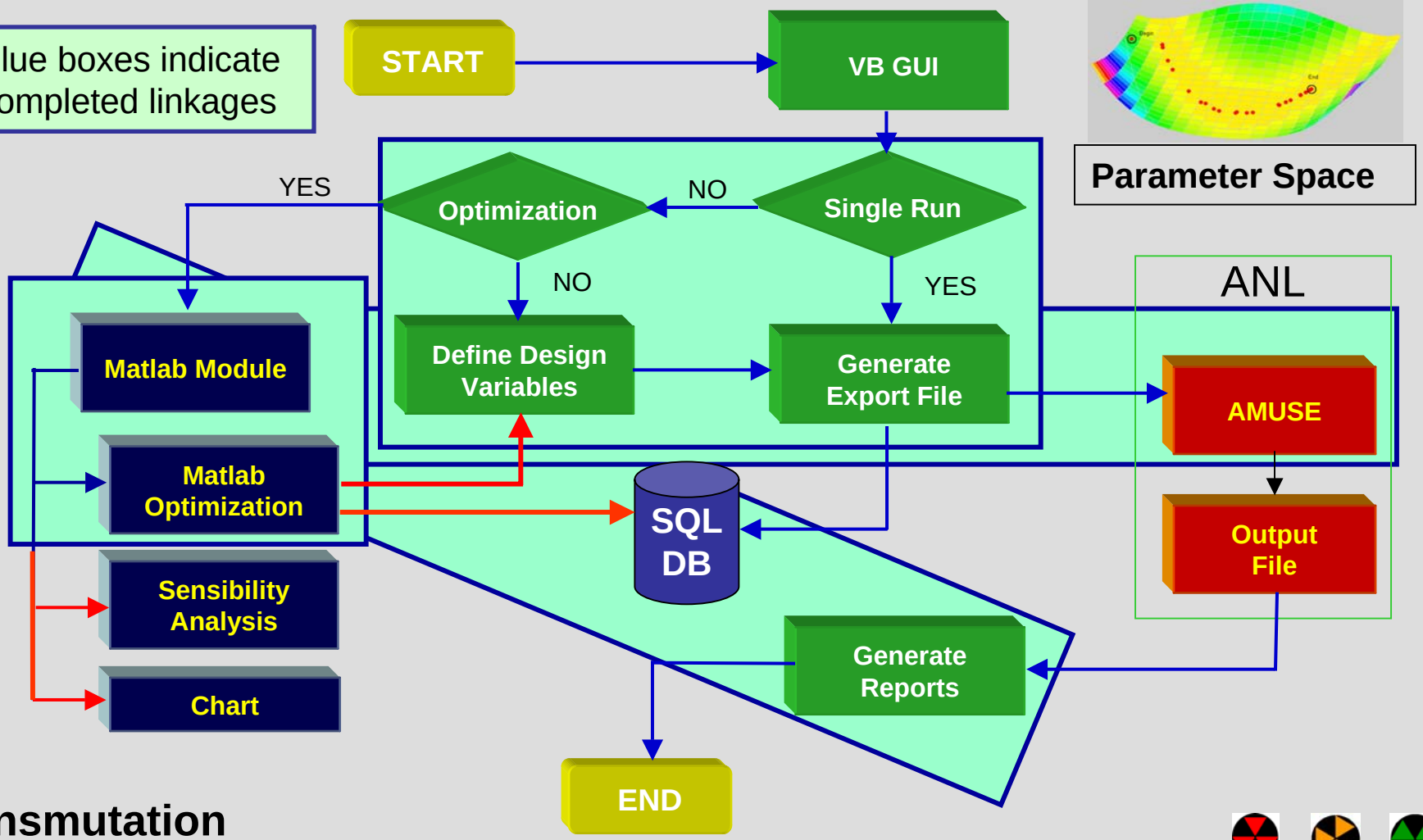
Task 8: System Flow Chart

Blue boxes indicate completed linkages



Parameter Space

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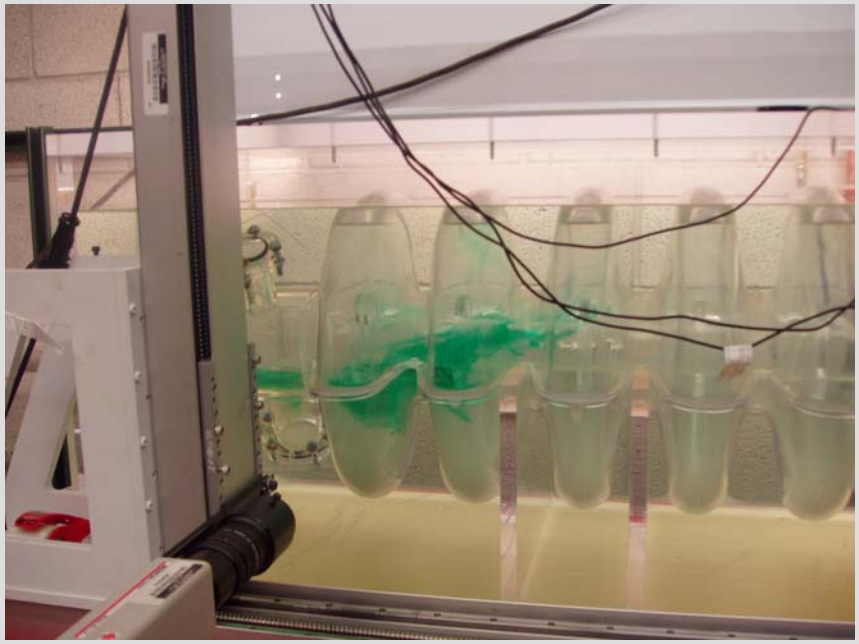
Task 2: Nb Cavity Optimization

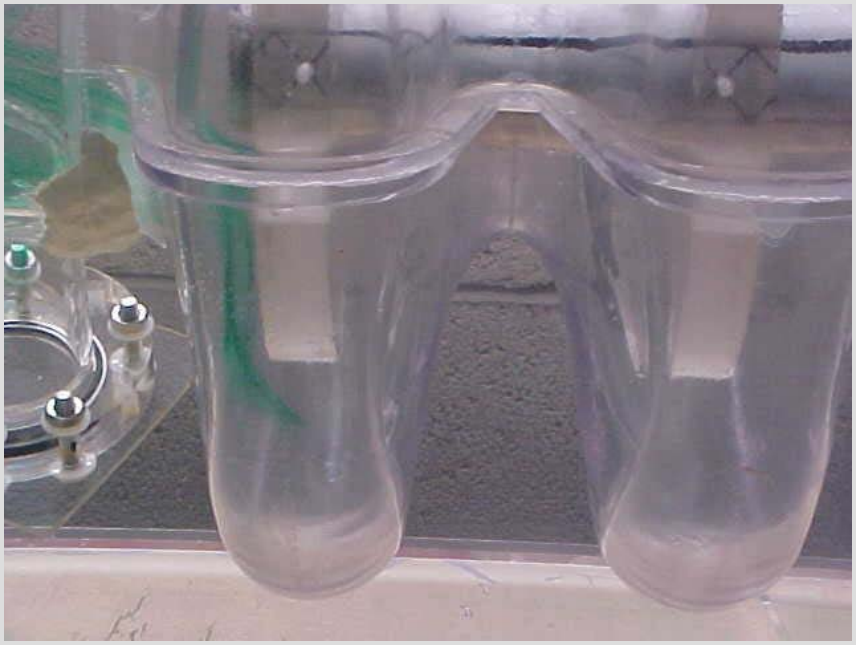
- Analysis of Etching Process
  - Flow Visualization of Etching (original baffle) verifies model prediction of flow path
  - Now testing Modified Baffle Design
- Modeling of Multipacting
  - Modeling used to design new experiment
    - Measure parameters controlling multipacting
    - Validate models and codes
- Optimization of Cavity Design
  - Evaluating new designs to minimize multipacting and simplify polishing/cleaning

Task 2: Flow Visualization of Etching Process

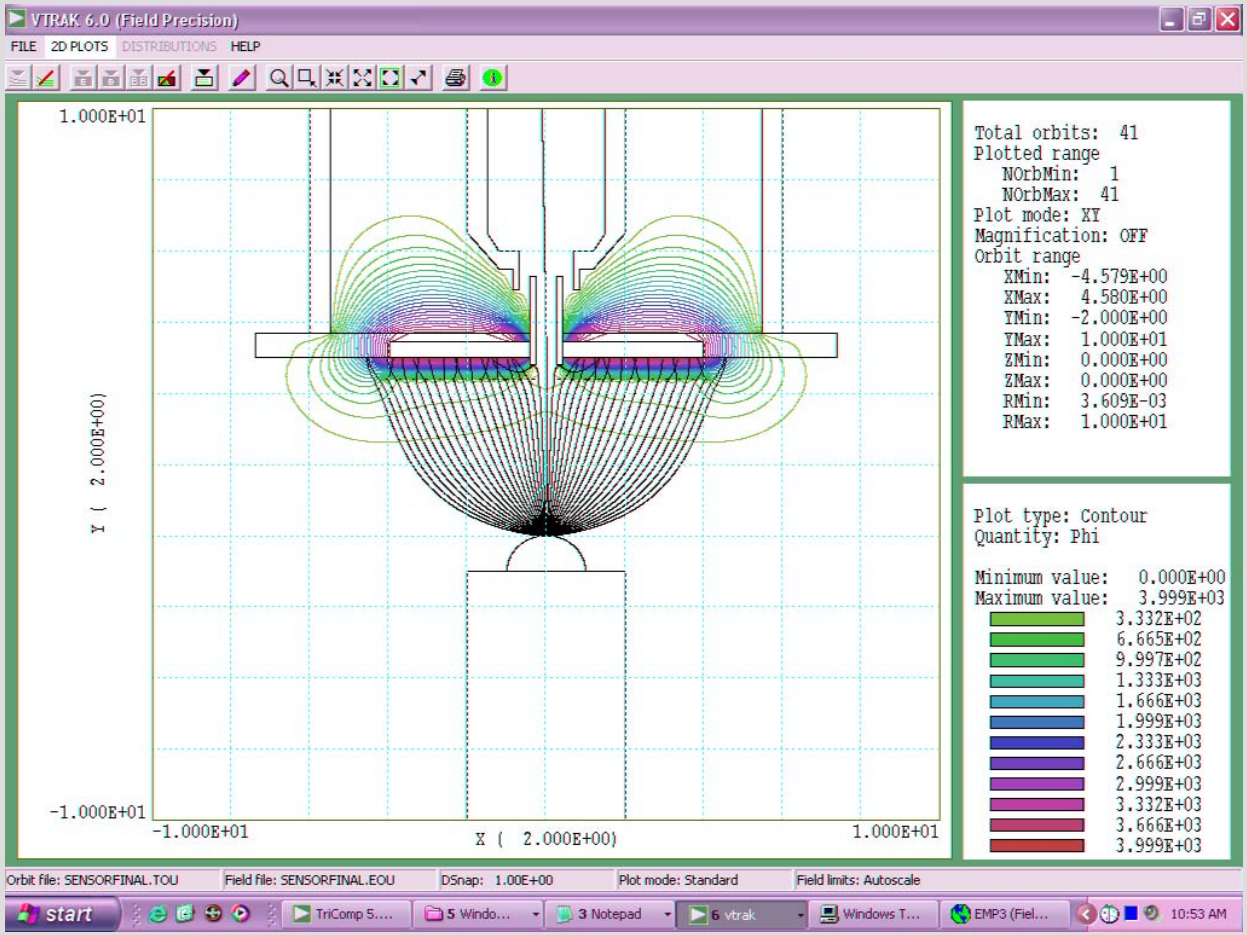
Original Baffle Design



Modified Baffle Design



Task 2: Secondary Electron Detector Design



Detector Model

Secondary Particle

- 20 eV electrons

Primary beam:

-Centered on target

Voltage on system

- 4 kV (detector)

- 0 V (grid)

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